

CLAIMS

1. A semiconductor structure comprising:
a monocrystalline silicon substrate ;
5 an amorphous oxide material overlying the monocrystalline silicon substrate ;
a monocrystalline perovskite oxide material overlying the amorphous oxide
material ;
a monocrystalline compound semiconductor material overlying the
monocrystalline perovskite oxide material; and
10 an arrayed wavelength grating device overlying the monocrystalline silicon
substrate .
2. The semiconductor structure of claim 1, wherein:
the arrayed wavelength grating device functions as a multiplexer.
- 15 3. The semiconductor structure of claim 1, wherein:
the arrayed wavelength grating device functions as a demultiplexer.
4. The semiconductor structure of claim 1, wherein:
20 the arrayed wavelength grating device functions as a router.
5. The semiconductor structure of claim 1, wherein:
the arrayed wavelength grating device functions as a switch.
- 25 6. The semiconductor structure of claim 1, wherein:
a temperature sensitivity of the arrayed wavelength grating device is tunable.
7. The semiconductor structure of claim 1, wherein:
a polarization dependent wavelength of the arrayed wavelength grating device
30 is tunable.

8. The semiconductor structure of claim 1, wherein:
a channel wavelength offset of the arrayed wavelength grating device is tunable.

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9. The semiconductor structure of claim 1, wherein:
the arrayed wavelength grating device includes

a plurality of electro-optical waveguides formed within the monocrystalline compound semiconductor layer, each waveguide of the plurality of
10 electro-optical waveguides carrying an optical signal of a distinct wavelength, and
a first electrode formed in the monocrystalline compound semiconductor layer and above the plurality of electro-optical waveguides, the first electrode operable to provide a distinct phase shift to each waveguide of the plurality of electro-optical waveguides in response to an application of voltage to the first
15 electrode.

10. The semiconductor structure of claim 9, wherein:

the arrayed wavelength grating device further includes
a planar waveguide region in optical communication with the plurality
20 of electro-optical waveguides, and
a second electrode formed in the monocrystalline compound semiconductor layer and above the planar waveguide region, the second electrode operable to tune a temperature sensitivity of the plurality of electro-optical waveguides.

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11. The semiconductor structure of claim 9, wherein:

the arrayed wavelength grating device further includes
a planar waveguide region in optical communication with the plurality
of electro-optical waveguides, and
30 a second electrode formed in the monocrystalline compound semiconductor layer and above the planar waveguide region, the second electrode

operable to tune a polarization-dependent wavelength of the plurality of electro-optical waveguides.

12. The semiconductor structure of claim 9, wherein:
- 5 the arrayed wavelength grating device further includes
- a planar waveguide region in optical communication with the plurality of electro-optical waveguides, and
- a second electrode formed in the monocrystalline compound semiconductor layer and above the planar waveguide region, the second electrode
- 10 operable to tune a channel wavelength offset of the plurality of electro-optical waveguides.

13. A process for fabricating a semiconductor structure comprising:
providing a monocrystalline silicon substrate ;
depositing a monocrystalline perovskite oxide film overlying the
5 monocrystalline silicon substrate , the film having a thickness less than a thickness of
the material that would result in strain-induced defects;
forming an amorphous oxide interface layer containing at least silicon and
oxygen at an interface between the monocrystalline perovskite oxide film and the
monocrystalline silicon substrate;
10 epitaxially forming a monocrystalline compound semiconductor layer overlying
the monocrystalline perovskite oxide film; and
forming an arrayed wavelength grating device overlying the monocrystalline
silicon substrate .
- 15 14. The process of claim 13, wherein:
the arrayed wavelength grating device functions as a multiplexer.
15. The process of claim 13, wherein:
the arrayed wavelength grating device functions as a demultiplexer.
- 20 16. The process of claim 13, wherein:
the arrayed wavelength grating device functions as a router.
17. The process of claim 13, wherein:
25 the arrayed wavelength grating device functions as a switch.
18. The process of claim 13, wherein:
a temperature sensitivity of the arrayed wavelength grating device is tunable.
- 30 19. The process of claim 13, wherein:
a polarization dependent wavelength of the arrayed wavelength grating device
is tunable.

20. The process of claim 13, wherein:
a channel wavelength offset of the arrayed wavelength grating device is tunable.

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21. The process of claim 13, wherein the
the arrayed wavelength grating device includes

a plurality of electro-optical waveguides formed within the
monocrystalline compound semiconductor layer, each waveguide of the plurality of
10 electro-optical waveguides carrying an optical signal of a distinct wavelength, and
a first electrode formed in the monocrystalline compound
semiconductor layer and above the plurality of electro-optical waveguides, the first
electrode operable to provide a distinct phase shift to each waveguide of the plurality
of electro-optical waveguides in response to an application of voltage to the first
15 electrode.

22. The process of claim 21, wherein:

the arrayed wavelength grating device further includes
a planar waveguide region in optical communication with the plurality
20 of electro-optical waveguides, and
a second electrode formed in the monocrystalline compound
semiconductor layer and above the planar waveguide region, the second electrode
operable to tune a temperature sensitivity of the plurality of electro-optical
waveguides.

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23. The process of claim 21, wherein:

the arrayed wavelength grating device further includes
a planar waveguide region in optical communication with the plurality
of electro-optical waveguides, and
30 a second electrode formed in the monocrystalline compound
semiconductor layer and above the planar waveguide region, the second electrode

operable to tune a polarization-dependent wavelength of the plurality of electro-optical waveguides.

24. The process of claim 21, wherein:

5 the arrayed wavelength grating device further includes

a planar waveguide region in optical communication with the plurality of electro-optical waveguides, and

10 a second electrode formed in the monocrystalline compound semiconductor layer and above the planar waveguide region, the second electrode operable to tune a channel wavelength offset of the plurality of electro-optical waveguides.